Update of Kalman Fitting

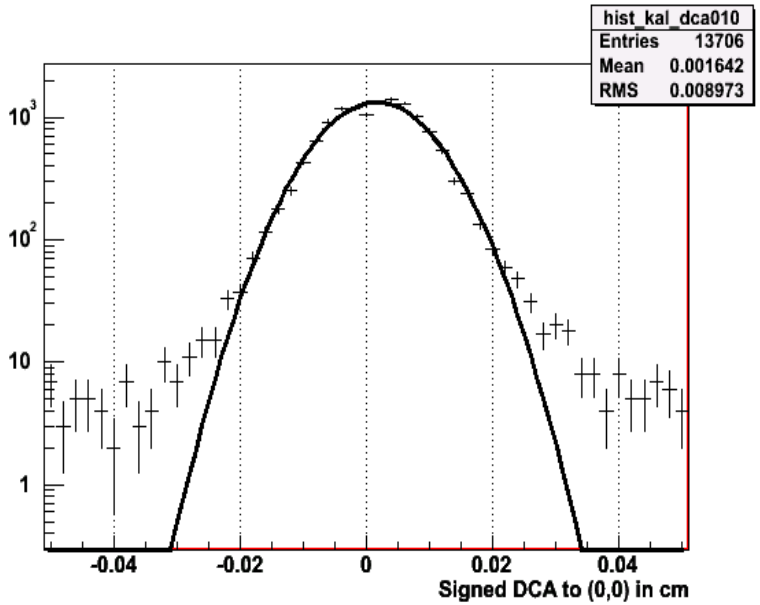
Hua Pei
Iowa State University

We are using 3 kinds of particles input in SVX simulation:
1) single pi+, pt = 2GeV
2) single D0, pt = 2GeV
3) single pi+ from the full-event generator of Exodus

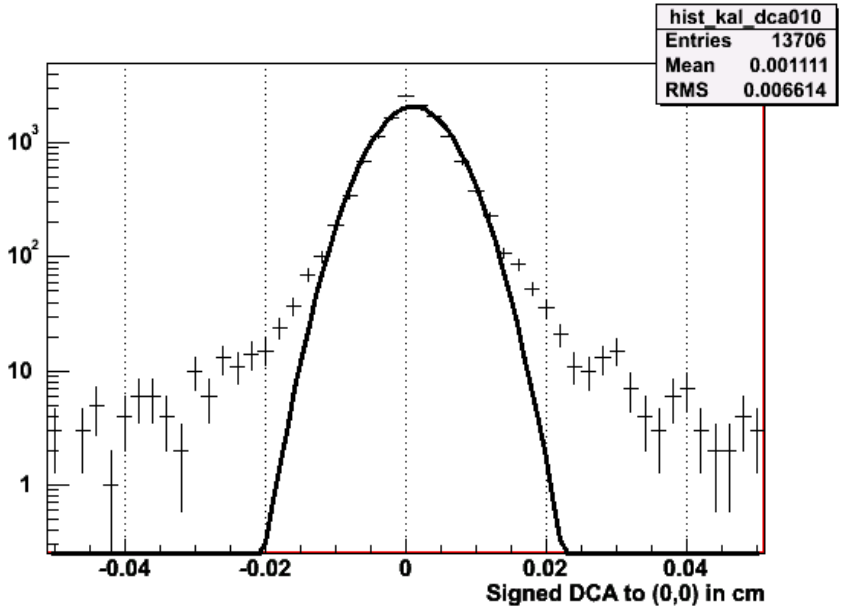
And for all the tracks, we select those got pt fit between 1.7 and 2.3GeV in Cgl package, and send them into Kalman Fitting. This fitting procedure will read in the initial collision vertex(always (0,0,0)) and initial momentum vector information from Cgl, then use all associated hits on SVX, DC and PC1 to try to push the track to them with smoothing.

The most important change since my last show is that I now find the nearest point on the track to collision vertex in X-Y plane only. When I was doing it in 3-D space, the worse z-resolution might add more error. However, the value of DCA has always been calculated in 2-D way: sqrt(x^2+y^2). The “x” and “y” are the coordinate of the point of closest distance.

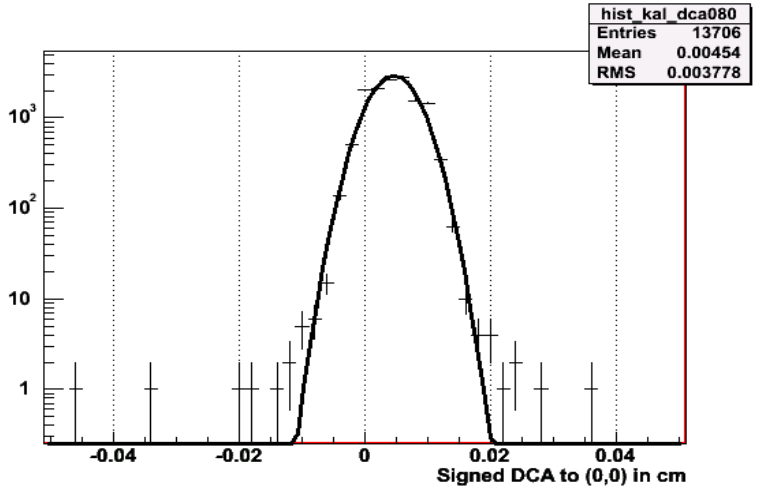
Step 1: Check if moving from 3-D to 2-D really improves DCA for single pi+, since we know it should be 0 in ideal case. I have to remind that both are calculated by sqrt(x^2+y^2). We only search for it in two ways.



3-D DCA, sigma = 79um

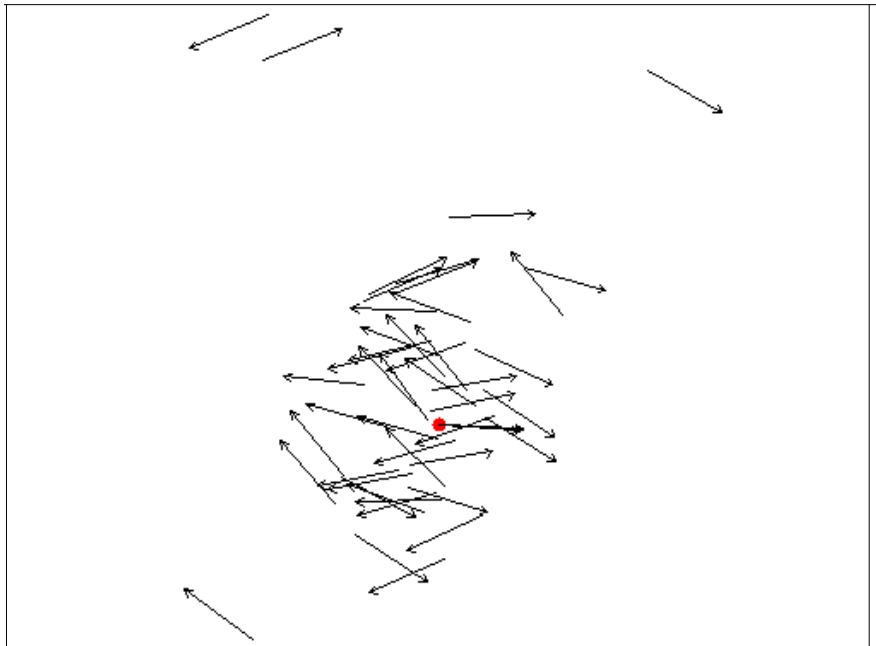


2-D DCA, sigma = 50um

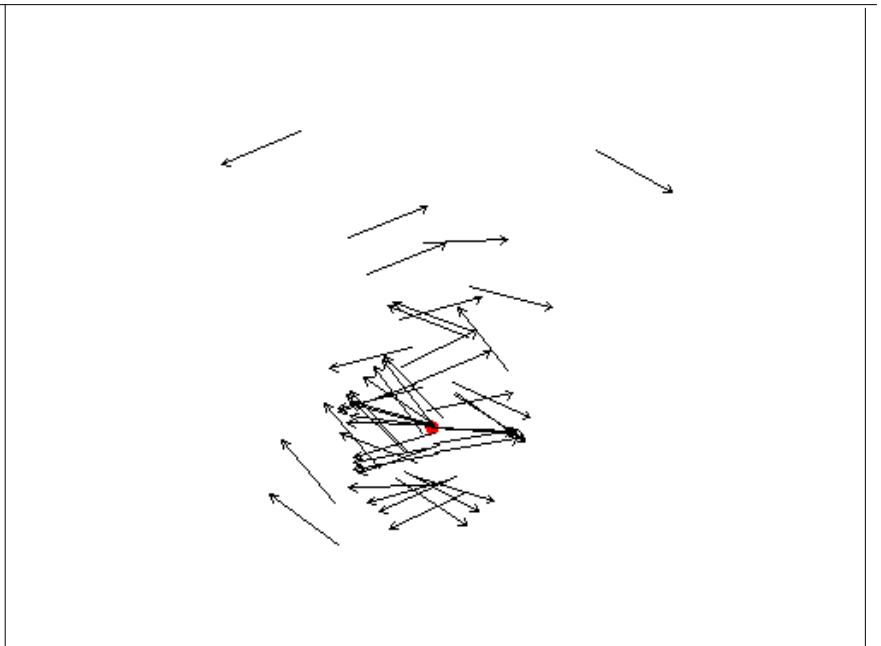


As a reference, the distance from the straight line (fitted by the two hits on pixel layers) to collision vertex in X-Y plane has a distribution as left plot. The sigma is 36 um

A cross-check of Step 1: We are going to plot the x-p vector of the point of DCA. All arrows start from (x,y) and direct to (px, py). The red point at center is the collision vertex. In X-Y plane, a perfect fitting requires the line connect (x,y) and (0,0) should be perpendicular to the vector.



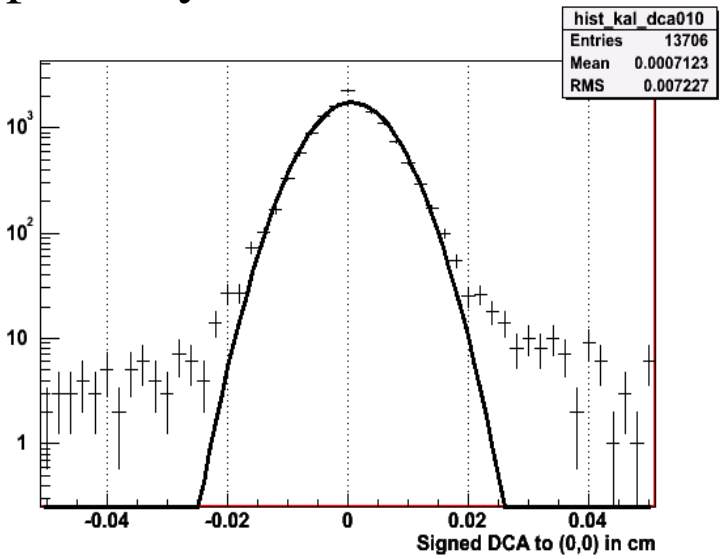
Old 3-D way of DCA



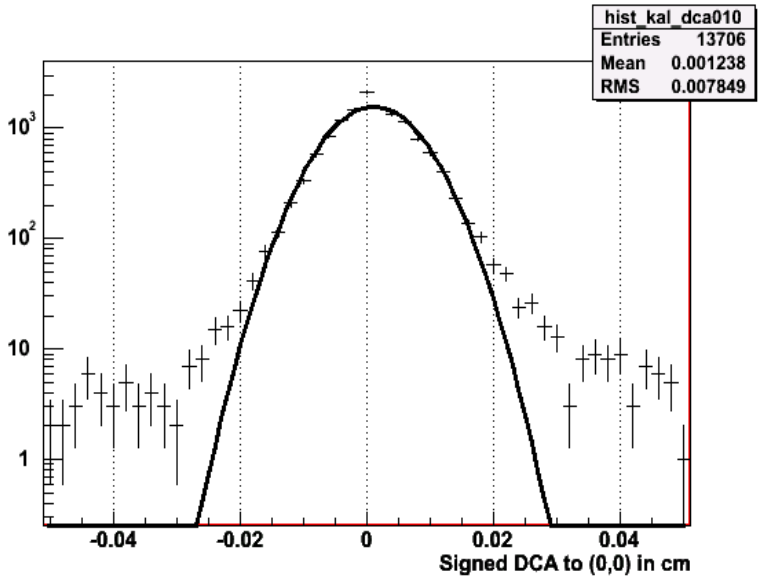
New 2-D way of DCA

Both plot are made in a range of 250um X 250um, using the same 200 single pi+ events

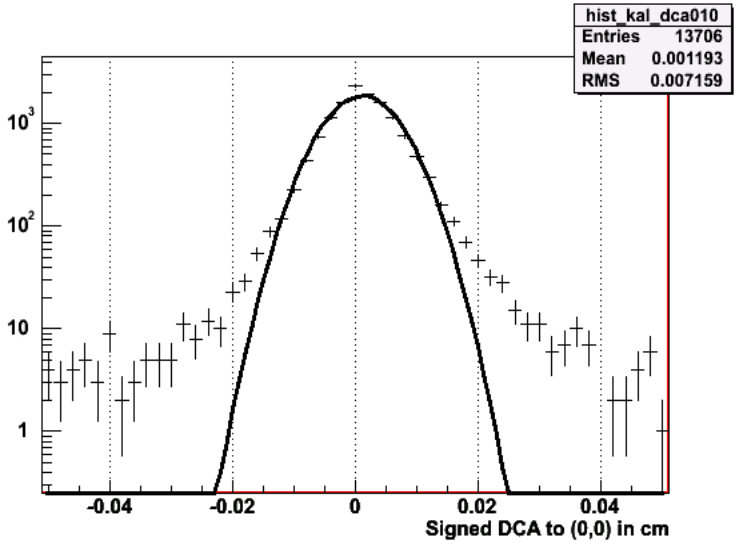
Step 2: Check if adding more layers makes DCA better. We know for single pi+ they should be 0 in ideal case



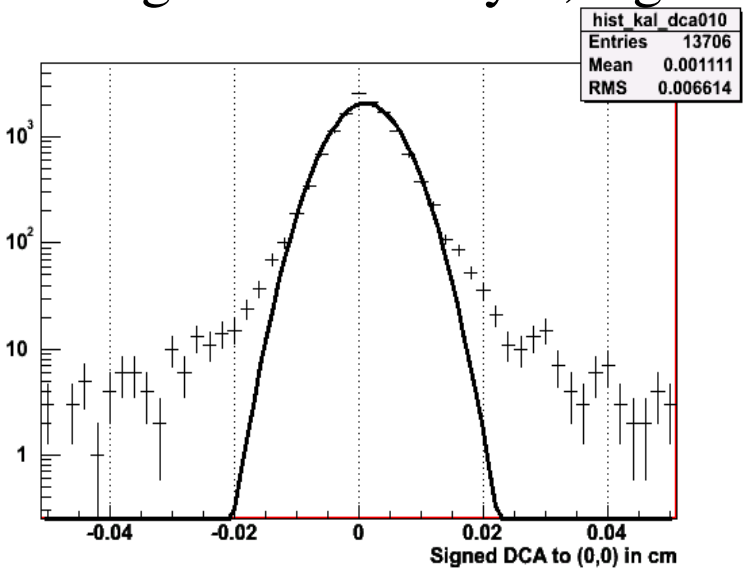
Using 1st layer, sigma = 60um



Using 1st and 2nd layer, sigma = 67um (?)



Using 1st, 2nd and 3rd layer, sigma = 56um

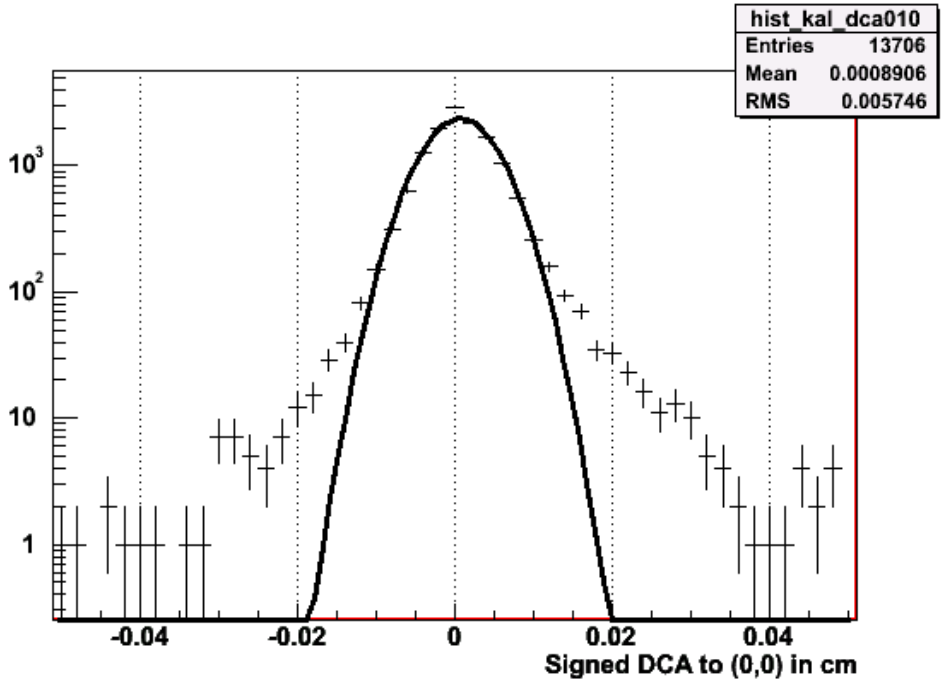


Using all 4 layers, sigma = 50um

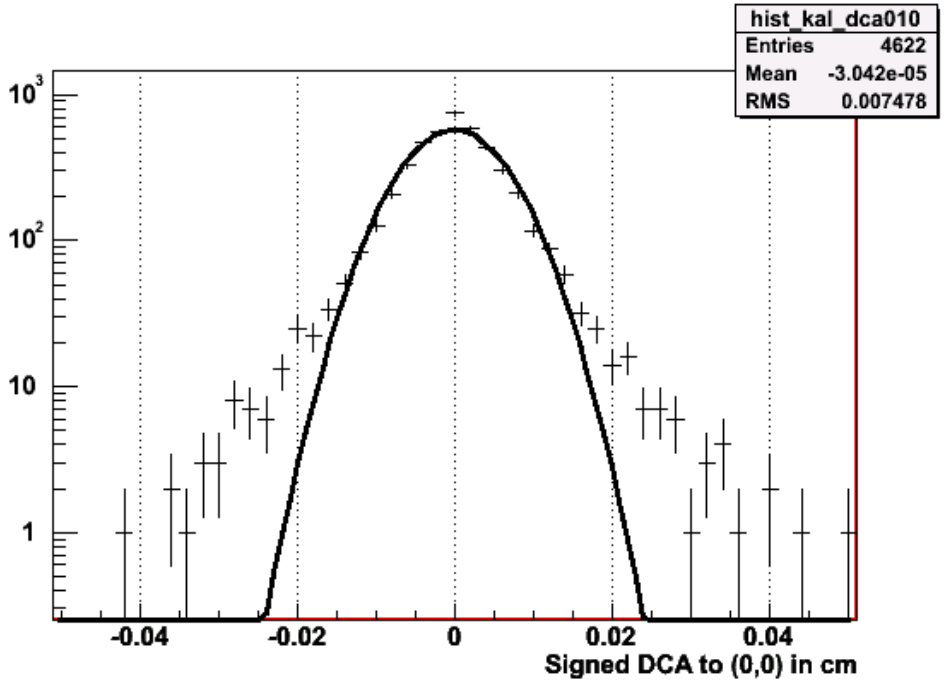
Step 3: Compare the DCA fitting result between single pi+, decay tracks from D0, and those single pi+ from full-event generator of Exodus.

Track cutting:
quality of track = 31 or 63
1.7 GeV < Pt of track < 2.3 GeV

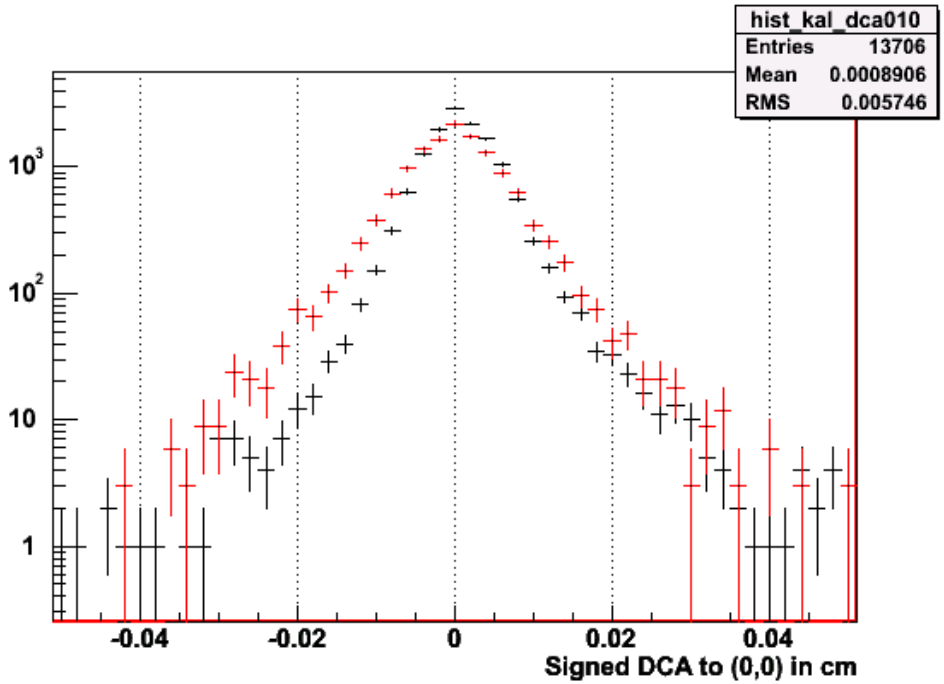
Kalman Fitting:
Search for point of DCA in X-Y plane
Let Kalman associate hits on SVX, and Cgl associate hits on DC and PC1
Iterate the fitting procedure over all associated hits 5 loops



Single pi+ : sigma = 44 um

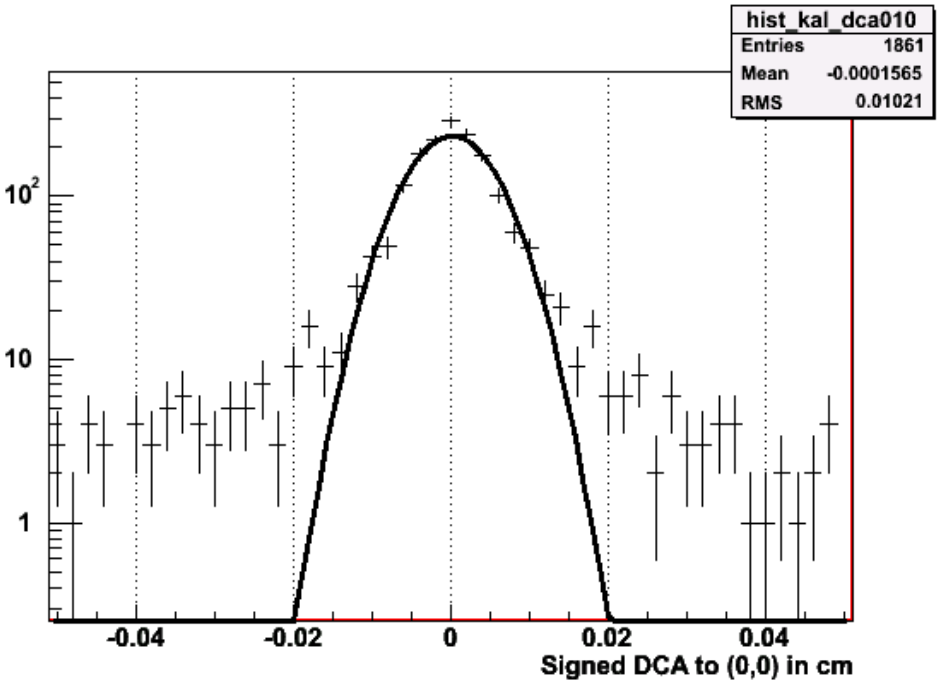


Decay tracks from D0 : sigma = 61um



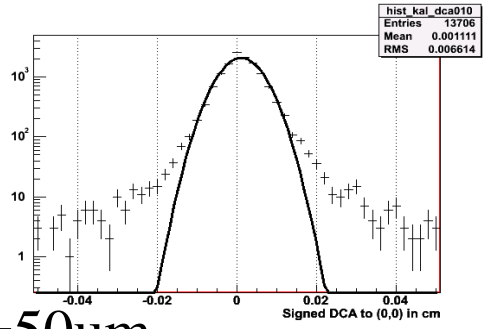
Overlapping display,
the black markers are of single pi+
the red markers are of decay tracks

Step 4: What do we see in full-event?

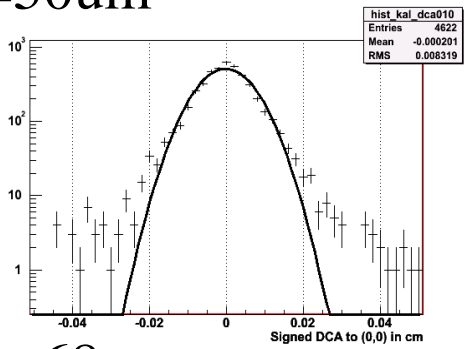


The sigma of pi+ in full-event is 54um. If we believe the previous page: $\text{sigma}_{\text{singlepi+}}$ = 44um and $\text{sigma}_{\text{decay\_tracks}}$ = 61 um, it will be hard to cut between direct pi+ and decay tracks in full PHENIX event

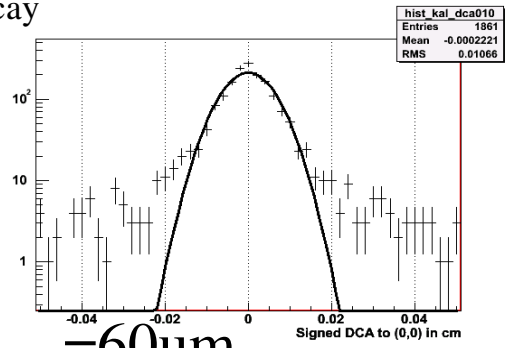
DCA after 1 loop, whose sigma bigger than those after 5 loops



$\text{Sigma}_{\text{pi+}}$ =50um



$\text{Sigma}_{\text{decay}}$ =68um



$\text{Sigma}_{\text{exodus}}$ =60um

Summary

We need to understand how DCA are affected by using different ways of searching for it

If Kalman makes sigma of DCA decrease by doing more iteration loops, then we need to consider if it's worthwhile to do this, even if Kalman does nothing wrong. More loops will cost much more time, and may decrease S/B within same cut of DCA

After the results are double checked, it may be possible to mix decay tracks from D0 with direct pi+ from exodus, or to do embedding test.